Proceedings – 23rd Annual Conference – IEEE/EMBS Oct.25-28, 2001, Istanbul, TURKEY

HOME HEALTH TELECARE AND THE ELDERLY IN SPAIN: TECHNOLOGIES INVOLVED AND METHODOLOGICAL ISSUES

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Abstract – **In this paper we try to develop a pilot experience in home care teleservices to the elderly through the investigation of solutions based on the application of information technologies and communications. To that end, an individualized attendance to each elderly person will be supplied, which will comprise from the monitorization of certain biological variables, its diagnosis and processing, to the advising to his/her family and their formation. In addition, a customized service will be offered, not only in the healthcare field, but also in a technological level.**

Keywords **– Home health telecare, information technologies, elderly people, virtual center.**

I. INTRODUCTION

Nowadays the developed countries are facing the genesis of a sequence of social and health problems for which public health systems are not prepared enough. These problems are generating demand of medical attendance different to that existing previously, and therefore cannot be resolved with current planning and resources. Thus, gaps in medical care are originating from the present situation, mainly at home, and even more in rural areas, which force society to do a "bad use" of medical attendance.

In different countries Home Care is emerging as a response. The aim is to keep these patients at home with the best quality of life. Home Care currently comprises a varied set of support services to handicapped and dependent people, including services to help in the daily life activities and even professional medical care with sophisticated technologies [1].

Research work on home care is increasing with several causes to explain this recent interest, including among the most important topics the progressive aging of population, the changes in the structure of family [2] and the saturation in hospitals.

In Spain population over 65 represent a 17 % of the total and the trend is to increase this figure in the following twenty years to a 25 % [3]. Unlike other surrounding countries only 8 % of the population receive home health care and only 0.18 % social services [4]. Although the trend is to extend coverage currently Home Health Care Services are not structured in our country. Consequently is it necessary to give social and health resources a new direction to resolve this deficient medical attendance in a population group with loss of self-care capability, to avoid hospital saturation and an uncontrolled increase of costs.

In order to achieve this objective it is essential to seek technical solutions that take advantage of home health telecare. Among the new methods Information Technologies (IT) provide telematic applications which include the collection of medical data at home and its transmission to a remote control center. By this means there are multiple benefits due to a reduction in the attendance load for the medical staff, the implication and participation of the relatives in the medical care, an improvement of efficiency and management of the medical centers, and a better quality of life since health care is delivered in the natural environment of the elders: their home. With regard to the quality of service, it is important to emphasize that home health telecare allows medical attendance to be delivered with more ease and frequency than it is possible with conventional channels.

In the light of this situation one important question to answer is whether home health telecare is a cost-effective solution. To answer this question, health costs based on age show that the elder people are the main consumers, and costs related to population over 75 is six times greater than mean population. Besides it is estimated that a 40 % of the total public health cost is inverted in people over 65. It is clear that redirecting the social and health resources that imply the greatest costs, bigger savings can be obtained [5]. Some of the principal implications of home telecare in health costs are a reduction of unnecessary hospital admissions and a reduction of stays in hospital supported by immediate home care after discharge. Besides, home health care programs contribute to increase the time a patient can spend without visiting his/her doctor, since they favor selfcare during a bigger period than conventional medical attendance [6].

From the technological point of view three generations of home health telecare for old people may be distinguished [7]. The first generation was based on devices that aided phone calls to a health care center. Among the solutions which are currently being investigated we should highlight those ones that transmit analog and digital signals and real-time video with an internet browser as a user interface [8]. In fact, internet offers a clear low-cost alternative to data transfer. In order to achieve an appropriate connectivity in the teleattended user environment, monitoring systems have been described which make use of communication networks based on power lines [9], wireless networks [10] or field-bus [11]. We can also cite teleconsultation systems based on remote-controlled video cameras [12]. Video is regarded as a communication form with more usefulness than audio, specially in people with cognitive restrictions.

From the commercial point of view, there are several companies offering partial solutions for home health telecare. However in most cases remote health services are reduced to a simple conversational phone call and those products based on the application of IT are frequently scarce of interoperability and do not fulfill end-user requirements. These obstacles together with a high cost price make these products unfeasible.

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
25OCT2001	N/A	-

Title and Subtitle Home Health Telecare and the Elderly in Spain: Technologies Involved and Methodological Issues	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) Biomedical Engineering Group, Dept. Systems and Automatics Engineering, University of Seville, Seville, Spain	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es) US Army Research, Development & Standardization Group (UK) PSC 802 Box 15 FPO AE 0949-1500	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)

Distribution/Availability Statement
Approved for public release, distribution unlimited

Supplementary Notes
Papers from the 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, October 25-28, 2001, Istanbul, Turkey. See also ADM001351 for entire conference on cd-rom., The original document contains color images.

Abstract

Subject Terms

Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU

Number of Pages
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In this paper research work is devoted to build a new concept on individualized medical attendance for the elderly. We report methodological issues about the application of IT for home health telecare. Two important hypothesis are taken as a starting point:

- There is a real need in the Public Health System to seek new alternatives that resolve the requirements of quality in medical attendance to the elderly, with sustained costs, in a population whose mean age is increasingly older.
- IT offer a growing potential to develop alternatives and new solutions in home care.

The first hypothesis is widely accepted today and this paper ratifies the second by the proposition of new methods and ideas in the field of IT applied to home health care.

II. METHODOLOGY

The objective of this paper is to develop new effective and safe IT-based solutions to home health telecare. To offer a personalized and remote home health care an appropriate methodology will have to be applied. We consider that the minimum basic specifications to be offered by these systems are the following:

- Low maintenance and easy handling of equipment on the part of the users.
- Respect for a full mobility of the teleattended users in their home. A real time monitoring of certain variables should be possible independently of location or household activities.
- Capability to detect falls and sudden changes of mobility.
- Reliable, safe and permanent connection to a service provider center with a guaranteed data confidentiality and privacy.

Among other minor objectives to be considered we will refer to:

- Determination of the most interesting biomedical variables, with an appropriate signal processing.
- Incorporation of modern biomedical sensors.
- Development of an open network architecture.
- Establishment of priority schemes in the presence of emergency situations.
- Design of intelligent interfaces and environments for the medical staff to remove IT barriers.

Considering the interdisciplinary character of this communication, for the accomplishment of these objectives it is necessary the participation of two work groups: a group of medical experts in geriatrics and a technical group. The medical group will be centered in the specification of user requirements, the selection of the study subjects, the acquisition of data and the validation of the technical proposals. The technical group will offer technical solutions to the requirements that are demanded.

Our vision of home telecare is based on the concept of a Virtual Center (VC) which acts as a service provider and serves as a communication vehicle between the teleattended elderly and the healthcare professionals. The applied methodology is summarized in Fig. 1 and explained in detail now.

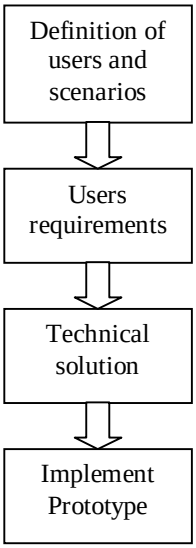

Fig. 1. Methodology for the design of a Virtual Center for the Elderly.

A. Definition of users and scenarios

From the functional point of view the following terms can be indistinctly applied to users in different scenarios:

- Teleattended users: old people who are being monitorized and receive home telecare.
- Professional users: include physicians, clinicians, nurses and those third persons who require the system to provide remote monitoring to the teleattended users. They may be professionally grouped in associations and/or geographically dispersed in peripheral centers, hospitals and emergency health centers.
- Service provider center: the proprietary organization of the VC, though not necessarily owner of all stored data. Management and maintenance of the system may be done the service provider center or by any private company subcontracted.

Access to the VC for teleattended users should be transparent and automatic and require small manual intervention. However there are other environments where the presence of this actor may not be discarded, e.g. a peripheral center or primary health care center, or where monitorization of several patients is desired.

Professional users may be distributed in several groups geographically dispersed. In this case the access to the VC will be provided by a personal computer, usually connected to a local area network. The service provider center will be in a location with communication resources required. The three scenarios are shown in Fig. 2.

B. Remote access unit

We will refer to the Remote Access Unit (RAU) when we talk about the device which allows acquisition of clinical data in the "point of care". Several methodological issues are to be taken into consideration.

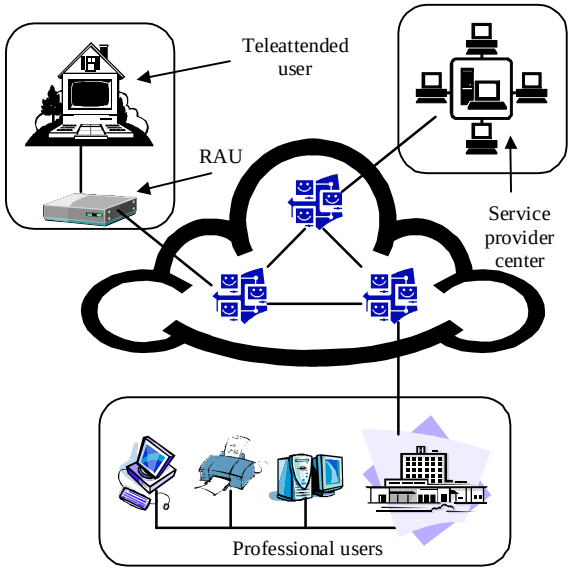

Fig. 2. Scenarios of a home telecare system.

The definition of the clinical variables to be obtained in the point of care will be established according to the requirements of the elderly. It is widely accepted that ECG, blood pressure, temperature and fall detection are key clinical variables. These ones may be combined with blood oxygen saturation and glucose determination to control the clinical state of a high proportion of elderly people.

In order to achieve a personalized medical attendance, a modular architecture must be designed for the RAU, which should be open to the incorporation of any other biosensors according to the requirements of each patient [13].

C. Connectivity

According to the different scenarios proposed there are three access forms to be provided. In the first scenario, a communication architecture must be designed to allow connectivity inside the patient's home from the point of care to the RAU. Comparing the different alternatives two technical solutions are compatible with restrictions on mobility: wireless and power-line networks.

- Access from the RAU to the VC will generally depend on a public network with the following specifications:
- Reliability and robustness: an error-free connection must be provided and access must be guaranteed at any moment.
- Privacy: data must be sent ciphered in order avoid access to private data.
- Low cost for the installation of a remote point of access.

Connection for professional users to the VC will be provided by another public network. Besides restrictions on reliability and privacy, to additional issues are important in this scenario:

- Scalability: the communications system should allow an increase in the number of users without being affected.
- High speed at bursts: access from professional users to the VC from the user interface must be as fast as any other application in the LAN of the health care center to which the professional user belongs.

D. Client-server architecture

The concept of VC relies on a client-server architecture model. The client application is the interface by which professional users access parameters and health care records of teleattended users through a service provider center. The server application comprises data processing and communications software to provide access to the VC to both professional and teleattended users.

Data management will be patient-oriented, making independent the VC's database (which collects specific information about measurements, events, etc.) from hospital databases. Data processing should be compliant with the Standard Query Language (SQL) and open data interfaces as ODBC may allow access to different data sources, independently of the operating system of the health care center.

III. Discussion

There are several technical alternatives for the different topics which have been described before. The main issues concerning design of present day telecare systems can be summarized in open architectures, modular and object-oriented programming languages, with extensions to be executed in real time, support for different communication interfaces (TCP/IP, Ethernet, USB, etc.) and plug and play integration for different components. Two emerging technologies are suitable for the database management system: OODBMS (object-oriented) and ORDBMS (object-relational).

With regard to biomedical sensor, the current trend is minimally invasive monitorization, with biosensors integrated into the natural environment of the patient [14]. This way data acquisition is performed in the required moment, with a minimum perceived intrusion. Among other examples the following have been described before: hearts/frequency monitors, nasal/oral temperature sensors, surface ECG and glucose determination by analysis of saliva [15]. Frequently biosensors are adhered to bracelets which can transported so that no anxiety is added to the old person during data acquisition [16]. In other cases, it is interesting to obtain vital signs without the sensor being in contact with the body. For example, textile electrodes have been reported to obtain ECG in bed [17]. In the case of elderly people, on of the most serious problems is fall detection, as a consequence of their loss of motive capability. These situations suppose high risk, mainly when they are alone. Fall detectors are an important help to theses emergency situations [18].

To offer a home telecare system customized to the requirements of the teleattended users, research on Personal Area Networks (PAN) will be essential [19]. During this decade we will be attending to the convergence of these networks with wireless communications and Internet [20]. Currently a great effort is being devoted to the definition of standards, including both physical level interconnection (HomePNA, HomeRF, BlueTooth) and service architecture and applications (HAPI, Jini, UPnP, etc.).

There are certain design issues which affect in an important degree in the efficiency of the application of IT, being one of

these the ease of use. A clear challenge of any product for home telecare is to make usage as easy as possible. The less the amount of operation requirements the elderly people need to learn about how to use the equipment, the better the sensation to feel sure and comfortable when they use it at home will be [21].

IV. Conclusion

In this paper we try to develop a pilot experience in home care teleservices to the elderly by the concept of a Virtual Center, through the investigation of solutions based on the application of information technologies and communications. To that end, an individualized attendance to each elderly person will be supplied, which will comprise from the monitorization of certain biological variables, its diagnosis and processing, to the advising to his/her family and their formation. In addition, a customized service will be offered, not only in the healthcare field, but also in a technological level.

The Virtual Center acts as a service-provider center, and serves as a communication vehicle between the teleattended elderly and the healthcare professionals. To that end, each user is equipped with a Remote Access Unit (URA) that will incorporate the recently advances in smart biomedical sensors, autocalibrated, noninvasive and that allow the mobility of the elderly person in their domestic environments. The possible situations of risk are alerted to the VC through this unit. In these cases, the access of the elderly to the VC will be made automatically and it will not be required manual intervention on the part of this one. Between these emergency situations special attention will be devoted to the detection of falls.

The accomplishment of a home care teleservice system like the one proposed, requires the establishment of an appropriate framework for the investigation in certain key technology areas, and a continuous dialogue between the medical, scientific and technical communities, which will lead to the establishment of end-user requirements and to find technological solutions for home-care teleservice systems. The results of this investigation will have an immediate transference to the enterprise sector, through the supply of new telecommunication services, and will contribute to the improvement in the quality of life of the elderly.

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